APPLICATION OF THE DRIVE SYSTEMS THROUGH THE STEPPER MOTORS IN THE PROCESS EQUIPMENT, MANIPULATORS, PUSHERS WITHOUT FEEDBACK

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Abstract – The current trend in the development of electric drive systems is the replacement of mechanical transmissions and kinematic connections by electric ones, that is, the fusion of an electric motor with a working element (actuating element). The main advantage of a stepper motor is the ability to realize precise positioning and speed control without applying feedback (speed, position). The limitation in the use of stepper motors is power and speed, but in practice, their use is entirely justified in inexpensive machine tools having a CNC system designed for processing wood, plastics, light metals and other materials of medium speed, the need for manufacturers of CNC machines for accuracy and speed. A conveyor line was developed on a system of stepper motors without feedback for the pharmaceutical industry.

Keywords – stepper motor, variable motion, design, drive system

I.INTRODUCTION

The current trend in the development of electric drive systems is the replacement of mechanical transmissions and kinematic connections by electric ones, that is, the fusion of an electric motor with a working element (actuating element). This simplifies the design of various drive systems, improves the quality of the regulation, increases the speed and reduces maintenance and operation costs.

At the same time, the exclusion of mechanical transmissions makes other demands on the power of the electric drive - a reduction in the speed of rotation, an increase in the torque on the shaft (linear speed, force, respectively, for the engines of translational action) [1-3].

For positional electric drives of small power, depending on the speed of the working element and the amount of movement, it is possible to use either collector motors (single-phase asynchronous, direct current) or stepper motors.

The main advantage of a stepper motor is the ability to realize precise positioning and speed control without applying feedback (speed, position). However, this advantage is valid only in the permissible range of moments and speeds indicated in the passport data for the engine. When the load is increased, the engine skips the steps and information about the position of the rotor is lost. That is, in the claimed range of moments and speeds, the stepper motor has a rigid mechanical characteristic.

To obtain an absolutely rigid mechanical characteristic of the collector motors, as well as to realize precise positioning and speed regulation in the electric drive system with a collector motor, it is necessary to use a subordinate control system with the installation of feedback sensors on controlled coordinates. This leads to an increase in the cost of the electric drive system.

Thus, for low power drives where positioning and precise speed control are required, high speed is not required, and the required torque and speed do not exceed the permissible limits, the stepping drive is the most economical solution.

The stepping electric motor consists of a stator, where the excitation windings (i.e., coils of electromagnets) and, respectively, the rotor with permanent magnets are located (also rotors with alternating magnetic resistance - but less often) are used. Stepper motor with a magnetic rotor allows to provide fixation of the rotor at deenergized windings and to receive a greater twisting moment. Due to this, stepper motors are often used in CNC machines.

The sufficiently high temperature, which is created in the coils, can easily dissipate through the mass of the engine itself, thus, the stepper motors from heating are less susceptible to damage.

The control of the stepper motor in its most general form reduces to the task of working out the determined number of steps in the required direction and at the necessary speed. The stepper motor control unit (i.e., the driver) is given certain signals to "make a step" - "set direction". These signals are nothing else than - 5B pulses.

These pulses can be obtained directly from the computer, for example, from the LPT port, from a specialized controller for controlling stepper drives or to set signals independently of the 5V generator or power supply.

Typically, the work of the stepper motor is controlled by an electronic circuit, and its power is supplied from a DC source. Stepper motors are used to control the speed of rotation, so as not to apply a feedback loop. This drive is used exclusively in the drive with an open circuit. To understand the difference between a conventional stepping motor and a servo motor, let's look at the operation of the system with the stepper motor, on which the encoder (step servo motor) stands directly (Fig.1 – 7).

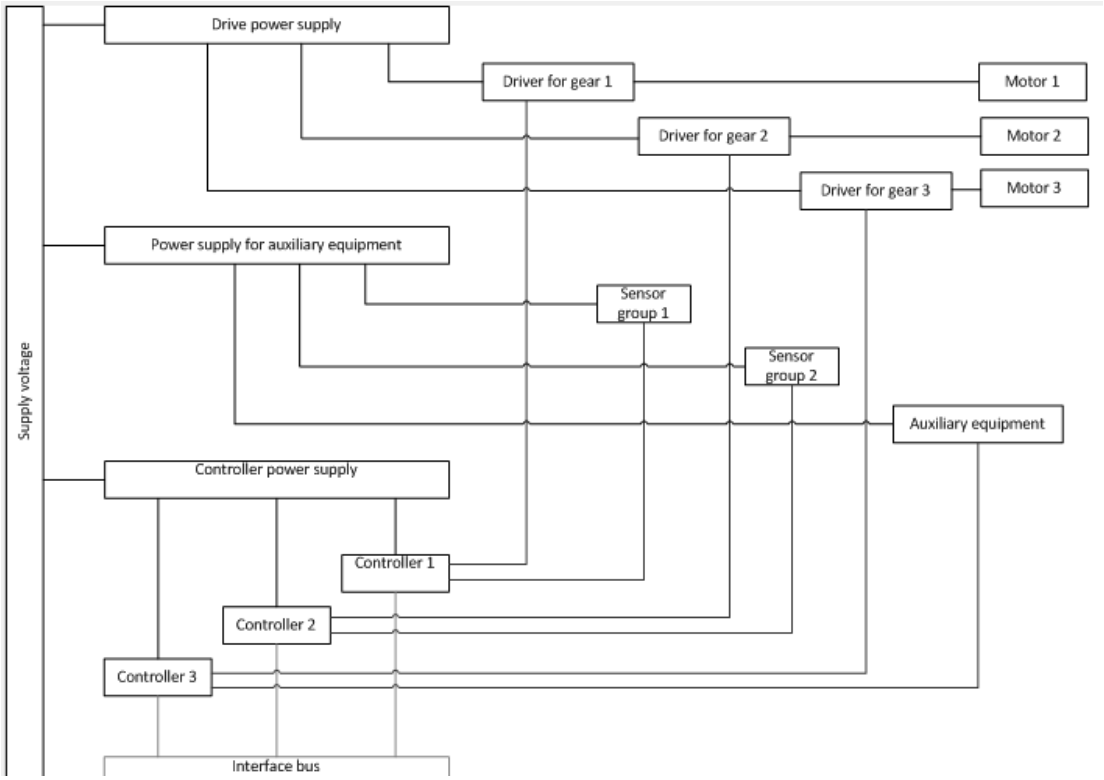

Fig. 1. The general block diagram of interaction of components of the conveyor

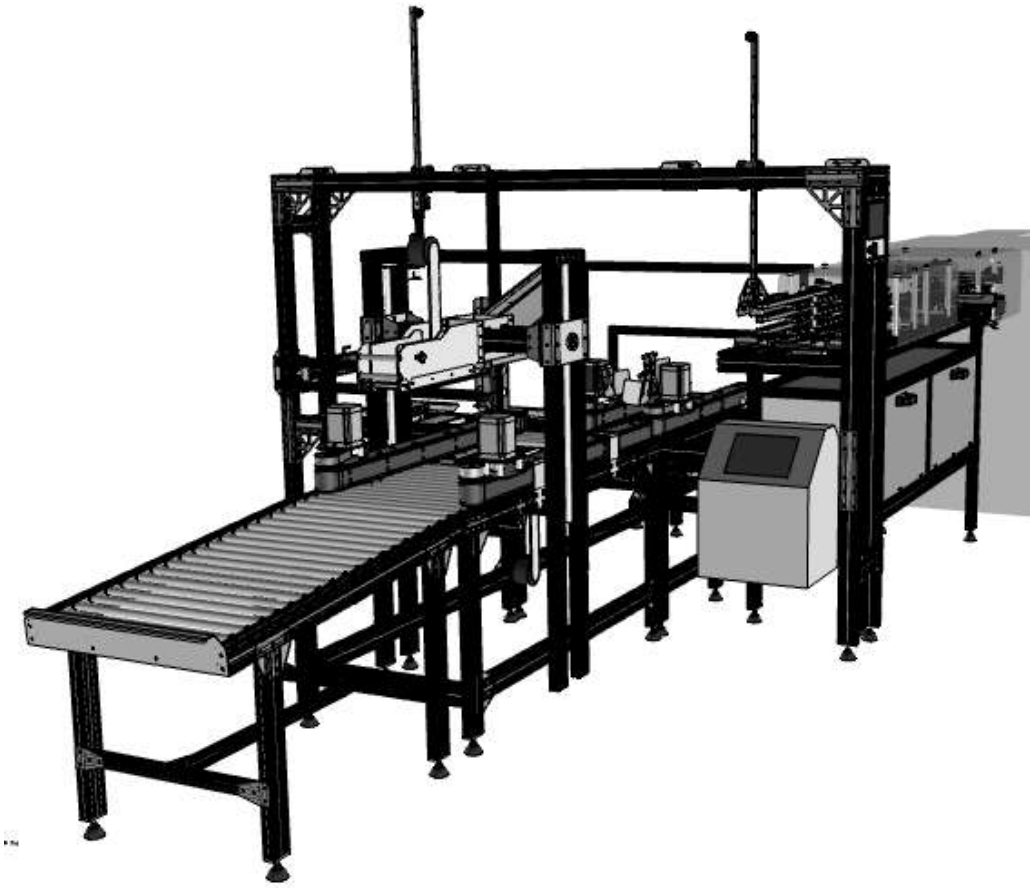

Fig. 2. Conveyor line using stepper motors without feedback, view from the side

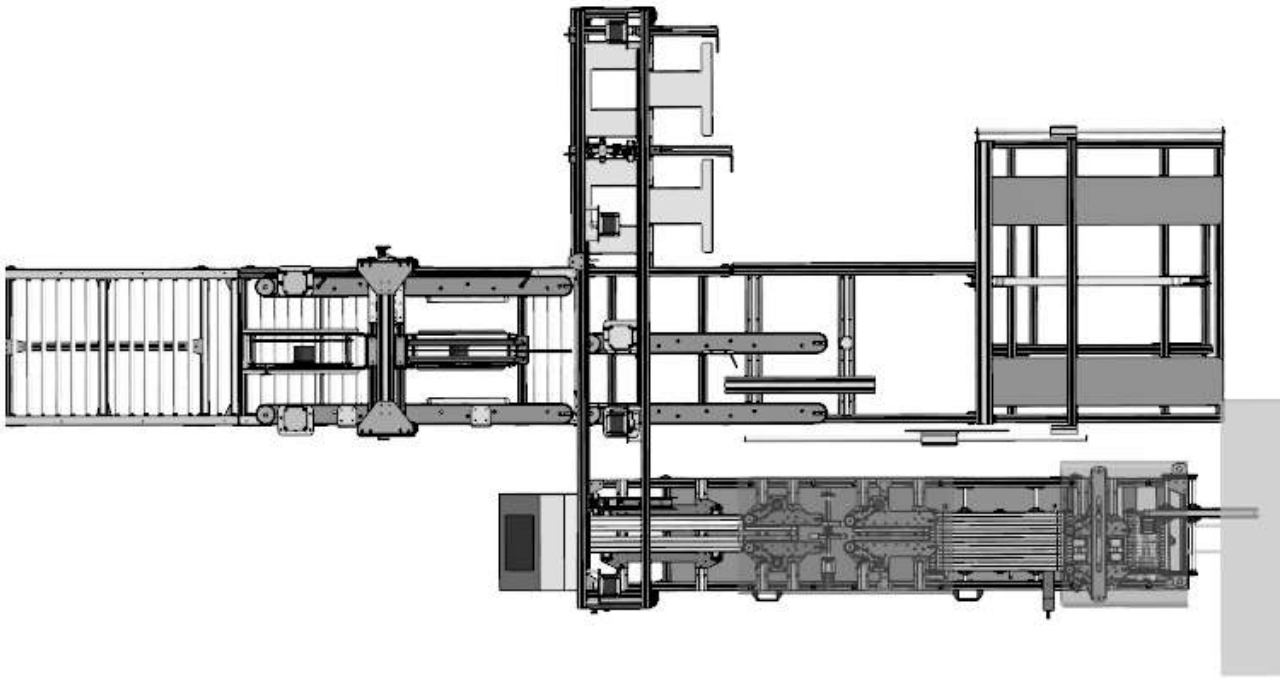

Fig. 3. Conveyor line using stepper motors without feedback, view from the top

Fig. 4. The conveyor line at the assembly stage

Fig. 5. The reception apparatus and transmitting products

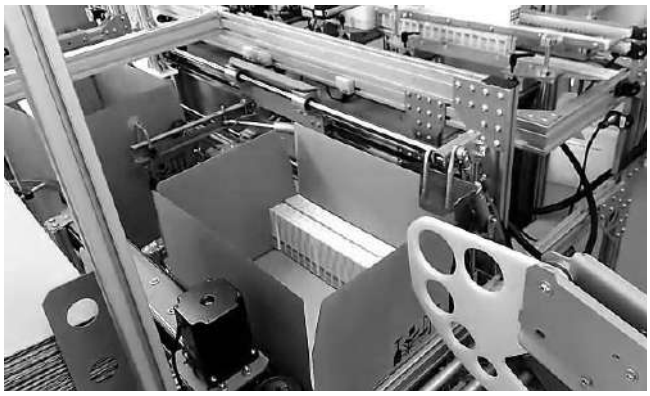

Fig. 6. The device layout of products in a box

Fig. 7. Conveyor line for moving and marking products

The controller issued a command for a number of steps - turn the shaft. In a conventional stepping motor, the controller does not know how much the shaft has turned (because it does not have feedback). He simply "believes" that the shaft has turned right. But it happens that the engine could not turn the shaft or the force was not enough, or for some other reason. Although the controller clearly counted the impulses. This is the so-called skipping step in the stepper motor. In the servo drive, the hold is carried out solely due to the current flowing directly through the motor winding. In this case, at the moment of holding half the period, the current flows in one direction, and the second half of the remaining time in a different direction. It is due to this that anchor retention occurs. At this time, the impulse from the encoder is suitable for checking whether the anchor is in place (there is no pulse at the output) or has shifted (as a rule, an impulse appears on the output of the encoder, or rather the code).

II. Conclusion

The limitation in the use of stepper motors is power and speed, but in practice, their use is entirely justified in inexpensive machine tools having a CNC system designed for processing wood, plastics, light metals and other materials of medium speed. If for some reason such parameters do not suit, then, as a rule, servos are used. But it is worth noting that, at the same time, the cost of the construction as a whole is sharply and, and significantly, increased.

If to look on the other hand, then real saving of processing time and even with high-speed servos can be achieved by saving on transitions and, accordingly, optimization of processing paths. In the rest of the time, the speed is very limited - cutting modes. Between the part and the drive there is also a milling cutter, which is often forgotten.

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